

XVI.—*Contributions to the Study of the chief Generic Types of the Palæozoic Corals.* By JAMES THOMSON, F.G.S., and H. ALLEYNE NICHOLSON, M.D., D.Sc., F.R.S.E., Professor of Natural History in the University of St. Andrews.

[Continued from p. 70.]

[Plate VIII.]

Genus DIPHYPHYLLUM.

Diphyphyllum, Lonsdale, Murch. Vern. & Keys. Russ. and Ur. p. 623.

Gen. char. Corallum compound—formed of long, slender, cylindrical corallites, which are usually placed at some little distance from one another, and are associated into fasciculate masses. The corallites have a distinct epitheca; and the mode of increase is by parietal or calicular gemmation. The septa are well developed, but do not reach the centre of the visceral chamber. Internally there is a small central area, occupied exclusively by the tabulæ. Externally the interseptal loculi are rendered vesicular by the development of dissepiments. No columella.

The typical corals of the genus *Diphyphyllum* form fasciculate masses, often of very large size, composed of cylindrical corallites, which may be occasionally united at certain points here and there, but are usually quite free. As rightly pointed out by Prof. de Koninck, Mr. Lonsdale was in error in asserting that the increase of the corallum was effected by means of fission of the old tubes. On the contrary, the increase is almost always by means of parietal or calicular gemmation, the old corallites continuing to grow, and the new corallites maintaining a position nearly parallel with that of the parents (Pl. VIII. fig. 1 A). It seems not improbable that, in one species, at any rate (viz. *D. Archiaci*, Billings), the corallum is occasionally simple; but this point requires further investigation.

The central area of each of the corallites is occupied by the tabulæ, which are perfectly smooth (Pl. VIII. fig. 1). The floor of the cylindrical, moderately deep calice of each is formed by the uppermost tabula in the centre. The septa do not encroach upon the median tabulate area; but we are unable to confirm M. de Koninck's view that this area is (as a rule, at any rate) surrounded by a special mural investment.

There are no traces of any columella; nor are there any grounds for believing that the absence of this organ is accidental, as formerly held by Milne-Edwards and Haime (Pol.

Foss. des Terr. Pal. p. 446). On the contrary, there is abundant evidence that no columella ever existed in any of the corals properly referred to *Diphyphyllum*.

The septa are well developed; but the primary ones invariably fall short of the centre, and leave the tabulæ exposed over a larger or smaller median space. Towards the circumference of the visceral chamber the interseptal loculi become filled by minute lenticular vesicles, formed by the development of numerous dissepiments (Pl. VIII. fig. 1).

The epitheca is thin, with encircling striæ, and occasionally accretions of growth. Sometimes there are horizontal outgrowths of the epitheca, uniting two adjacent corallites; but this is of rare occurrence.

Mr. Lonsdale's original definition of the genus *Diphyphyllum* is as follows (*op. jam cit.* p. 623, t. i.):—"A stony lamelliferous polypidom; lamellæ exceeding twelve, biplated; branched, branches dichotomous; internal structure triareal: (1) central area, intersected by flat, convex, or irregular diaphragms, no persistent axis; (2) intermediate area, traversed vertically by lamellæ; interspaces crossed obliquely or downwards by extensions of the diaphragms and subordinate plates; (3) outer area, traversed by lateral extensions of lamellæ; interspaces crossed by arched or vesicular laminæ inclined upwards and outwards; stems not uniformly thickened by external secretions, but occasionally united when in juxtaposition." The type species, upon which the above definition is founded, is *D. concinnum*, Lonsd., from the Carboniferous rocks of Russia.

Prof. McCoy (Brit. Pal. Foss. p. 87) followed Mr. Lonsdale in all essential points, more especially as regards the supposed fissiparous mode of increase, and defined the genus as follows:—"Corallum forming elongate cylindrical branches, dividing by dichotomous fissure of the main stem; no axis; biareal; the large central area occupied by strong, simple, transverse diaphragms, deflected at the circumference, surrounded by a narrow outer vesicular area; outer wall thick, radiating lamellæ numerous, not reaching the centre." He described two species, from the Carboniferous rocks of Britain, viz. *D. gracile* and *D. latiseptatum*, the latter of these being apparently identical with *D. concinnum*, Lonsd.

Milne-Edwards and Haime consider that *Diphyphyllum concinnum* was founded upon a *Lithostrotion* in which the columella had been accidentally destroyed, and they therefore reject the genus altogether (Pol. Foss. des Terr. Pal. p. 446). De Fromental adopts the same view, but retains the name of *Diphyphyllum* for the fasciculate species of *Lithostrotion* (Int.

à l'étude des Polyp. Foss. p. 304). Prof. de Koninck, however, by his excellent description and figures of the type form, *D. concinnum*, Lonsd., has thoroughly established the correctness of Mr. Lonsdale's original views and the validity of the genus (Nouv. Recherches sur les An. Foss., partie i. p. 36, pl. ii. figs. 4-4d, 1872). We need only add that the forms which we have examined from the Carboniferous rocks of Scotland and the Devonian rocks of America agree in all points of generic importance with the type form *D. concinnum*. We quite agree with Mr. Billings (Can. Journ., new series, vol. iv. p. 134), as well as with M. de Koninck, in thinking that Mr. Lonsdale was in error in making fissiparous division to be one of the characters of the genus; but this misconception as to a single character is not of itself sufficient to invalidate his definition or to lead to the abandonment of his name.

It follows from the above that the genus *Lithostrotion* is sufficiently separated from *Diphyphyllum* by the presence in the former of a well-developed and continuous columella, which is wholly wanting in the latter. Hence transverse and longitudinal sections will in all cases enable the palaeontologist to at once separate the *Diphyphylla* from the fasciculate species of *Lithostrotion*, in spite of the close external resemblance between the two groups.

From the typical species of *Cyathophyllum* the species of *Diphyphyllum* are at once separated by the limitation of the septa of the latter to the external portion of the corallum. In no case do the septa in *Diphyphyllum* meet in the centre of the visceral chamber, or become twisted together so as to form a pseudo-columella. This distinction, however, is not available as separating *Diphyphyllum* from forms like *Cyathophyllum paracida*, McCoy, or *C. (Caninia) giganteum*, Mich., since in these latter the septa fall short of the centre. In this case the chief available characters are to be found in the fasciculate growth of the former, and the strongly developed peripheral vesicular zone of the latter. When we come, however, to such forms as *C. caespitosum*, Goldf., it must be admitted that it is almost impossible to draw a rigid line between this and *Diphyphyllum*, since the septa in the former seem occasionally to fall short of the centre, and the form and mode of growth of the corallum are as in the latter genus.

Dybowski has recently founded the genus *Donacophyllum* (Mon. der Zoanth. scler. rug. aus der Silurform. Esthlands &c., p. 80) for corals which are said to differ from *Diphyphyllum* only in the fact that the vesicles of the exterior zone are of large size. We have seen no examples of the genus, and can pronounce no opinion as to its value.

The genus *Eridophyllum*, Edw. & Haime, is, again, precisely similar to *Diphyphyllum* in all the essential points of its internal structure, and differs only in the fact that the corallites are united at intervals by abundant lateral outgrowths of the epitheca. Occasionally, however, such epithecal outgrowths are sparingly developed in *Diphyphyllum*; and we are inclined to doubt if their absence or presence can be considered a ground of generic distinction. We do not think that Dybowski has brought forward any sufficient reasons for separating groups so closely allied, and placing them, as he has done (*op. jam cit.* p. 81), in different families.

The genus *Diplophyllum*, Hall, was founded for the reception of some corals from the Niagara Limestone (Pal. N. Y. vol. ii. p. 115), which in most respects agree with *Diphyphyllum*, but are stated to have the septa meeting in the centre of the visceral chamber. They are also stated to possess an inner mural investment surrounding the central tabulate area. This latter distinction, however, cannot be relied upon, since an inner wall (though certainly wanting as a rule in *Diphyphyllum*) is stated by De Koninck to be present in *D. concinnum*, Lonsd. Upon the whole, it seems probable that *Diplophyllum*, Hall, will prove on further examination to be properly referable to *Diphyphyllum*.

The geological range of the genus *Diphyphyllum* is a tolerably wide one. It appears to commence in the Upper Silurian, being represented in the Guelph Limestones of Canada. Several species are found in the Devonian rocks; and the genus is well represented in the Carboniferous. In the Carboniferous rocks of Scotland the genus is rare, but it is represented by the type species (*D. concinnum*, Lonsd.), as well as by another form at present undetermined.

Genus LOPHOPHYLLUM.

Lophophyllum, Edwards & Haime, Pol. Foss. des Terr. Pal. p. 349. and Brit. Foss. Cor. Intr. p. lxvi.

Gen. char. Corallum simple, conical, with a complete epitheca. Tabulæ convex, irregular, passing with more or less interruption completely across the visceral chamber. A septal fossette is present. A cristiform or clavate columella in the centre of the uppermost tabula, joined by one extremity with the single septum contained in the septal fossette, and sometimes connected by the other with the opposite primary septum. Septa extending nearly, but not quite, to the centre of the visceral chamber.

So far as is known, all the species of *Lophophyllum* are

simple, and their form is more or less conical and usually curved. The epitheca is complete, sometimes thin, but in other cases thick, with strong longitudinal striæ. Minute encircling lines of growth are present, along with annulations of growth. The calice is moderately deep, and the septa extend nearly to the centre of the visceral chamber, apparently without ever quite reaching it. Small secondary septa usually, but by no means always, alternate with the primary septa. As a general rule dissepiments are present, in the form of delicate plates crossing the interseptal loculi; but these are never developed in such quantity as to form a distinct zone of vesicular tissue exteriorly (Pl. VIII. figs. 5 A, 6 A, 7 A).

The tabulæ are always present, and are always well developed, though they do not possess the form of distinct, strong, transverse plates. On the contrary, they form a series of more or less irregular arched plates, with their convexities upwards, which anastomose and become more or less freely united with one another. They are not, however, confined to the central area of the corallum, but reach the inner surface of the wall (Pl. VIII. figs. 6 & 7).

The columella is invariably present, and is formed by a cristiform or clavate prominence in each successive tabula. It is thus not a true columella, as is sufficiently shown by longitudinal sections (Pl. VIII. figs. 6 & 7), where there is simply a pseudo-columellarian line passing down the centre. One extremity of this pseudo-columella is joined directly with the septum occupying the septal fossule. The other extremity seems sometimes to be connected with the primary septum directly opposite to the septal fossula; but more commonly it appears to be free, and no such connexion seems to be established (Pl. VIII. figs. 3 A-7 A). In *L. breve*, De Kon., the columellar prominence is said not even to have its usual connexion with the septum in the fossula. Though well marked in specimens exhibiting the interior of the calice, the septal fossule is not a conspicuous object in transverse sections of *Lophophyllum*, and is generally only recognizable by the fact that the columellar eminence is prolonged into it.

The genus *Lophophyllum* agrees in many respects with *Zaphrentis*, more especially in the characters of the septa and dissepiments. It is distinguished, however, from this by the comparatively irregular tabulæ, the different nature of the fossula, and the presence of the central columellar eminence. Almost the only genus with which *Lophophyllum* runs any risk of being confounded is *Cyathaxonia*, Mich.; but sections at once show that it is fundamentally distinguished from the latter by the possession of tabulæ. In *Cyathaxonia*, also,

there are no endothecal dissepiments, and the columella forms a single styliform rod, which commences at the bottom of the visceral chamber, and is continued through to the floor of the calice. (It may not be out of place to note here that *Cyathaxonia Dalmani*, E. & H., is not a true *Cyathaxonia*, but has been formed into a new genus by Lindström under the name of *Centrotus*.)

The genus *Lophophyllum* commences in the Devonian, but attains its maximum in the Carboniferous rocks, where it dies out. All the known species are small, rarely exceeding an inch or an inch and a half in length. The type of the genus is *L. Konincki*, E. & H., from the Carboniferous rocks of Belgium. With the exception of a form which seems to be identical with *L. (Cyathopsis) eruca*, M'Coy, all the examples figured by us (Pl. VIII. figs. 3-6) are new; but we reserve the description of their specific characters till another occasion.

EXPLANATION OF PLATE VIII.

(All the figures are drawn of the natural size.)

- Fig. 1.* *Diphyphyllum concinnum*, Lonsd., transverse section of a small slab, exhibiting calicular gemmation at different stages of the process; 1 A, longitudinal section of the same, showing the production of young corallites and the continued growth of the parent tubes. Lower Carboniferous, Bathgate, Linlithgowshire.
- Fig. 2.* *Diphyphyllum*, sp., transverse section of a small slab, exhibiting fissiparous development of the corallites. Lower Carboniferous, Scotland.
- Fig. 3.* *Lophophyllum parvulum*, Thomson & Nicholson, external aspect; 3 A, transverse section of the same. Lower Carboniferous, Fifeshire.
- Fig. 4.* Another example, from the Lower Carboniferous of Ayrshire; 4 A, transverse section of the same.
- Fig. 5.* *Lophophyllum reticulatum*, Thomson & Nicholson, external aspect; 5 A, transverse section of the same. Lower Carboniferous, Shiels, East Kilbride.
- Fig. 6.* *Lophophyllum*, sp., longitudinal section; 6 A, transverse section of the same. Lower Carboniferous, Shiels, East Kilbride.
- Fig. 7.* *Lophophyllum eruca*, M'Coy (?), longitudinal section; 7 A, transverse section of the same. Lower Carboniferous, Brockley, near Lesmahagow, Lanarkshire.
- Figs. 8-8 B* belong to the next portion of this memoir, where their characters will be discussed.

[To be continued.]